PREDICTION OF BLUE WATER FOOTPRINT AT SEMAMBU AND PANCHING WATER TREATMENT PLANTS

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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Thesis submitted in fulfillment of the requirements
for the award of the
B. Eng (Hons.) Civil Engineering

Faculty of Civil Engineering & Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

Alhamdullilah, I would like to praise to Allah SWT for giving me this opportunity to complete my thesis. Thanks to Him for giving me a strength and a good health while conducting this research.

I would like to express sincere appreciation and thanks to my supervisor, Dr. Edriyana A. Aziz, for her guidance, advices and encouragement in all aspect through this research. High appreciation for her comments, criticism and willing to share her knowledge within this field. All the knowledge that she gave to me were precious and priceless.

I would also like to express my heartfelt to my beloved parents, Mat Akhir bin Ahmad and Halijah binti Abd. Wahab for the support and encouragement. Grate motivation from them boost up my spirit until I managed to complete this task.

Finally, not to be forgotten, my appreciation will go to En. Syazwan Nizam, lecturers, staffs and all my friends in final year in the Faculty of Civil Engineering and Earth Resources, for their ideas and supports. Thank you so much for all the help, information and braveness through all the difficult time in doing the project and to finish study. Highly appreciate and millions of love for all of you from me.

ABSTRAK

Permasalahan air di dunia sekarang menjadi isu yang membimbangkan disebabkan pembandaran yang semakin pesat. Terdapat banyak penyelidikan berkaitan air telah dilakukan untuk menangani masalah ini seperti (Chang, Chang, Huang, & Kao, 2016; Nguyen-ky et al., 2017; Rosecrans, Nolan, & Gronberg, 2017). Kajian ini tertumpu kepada penilaian jejak air biru (WFblue) di Loji Rawatan Air (LRA) Semambu dan Panching. Kemudian, jumlah jejak air biru akan dimodelkan dan menjalani satu siri latihan untuk meramalkan trend dengan menggunakan 2 algoritma iaitu Rangkaian Neural Buatan (ANN) dan Random Forest (RF). Perbandingan telah dibuat di antara kedua-dua algoritma bagi memilih algoritma terbaik dalam melakukan ramalan trend berkaitan air. Objektif kajian ini adalah: (1) untuk mengira jumlah WFblue di LRA Semambu dan Panching yang terletak di lembah Sungai Kuantan bagi tempoh 2015-2017, (2) untuk membandingkan algoritma terbaik antara ANN dan RF dalam model ramalan WFblue dan (3) untuk meramalkan trend WFblue di LRA Semambu dan Panching. Sehubungan dengan itu, jumlah pengambilan air, penggunaan hujan dan jumlah penyejatan akan diambil kira dalam pengiraan jumlah WFblue di mana WFblue boled ditakrifkan sebagai jumlah penggunaan air dalam rantaian produk. Pada akhir penyelidikan ini, jumlah WFblue telah berjaya dihasilkan. Trend yang diramalkan menunjukkan penurunan dari 2015 hingga 2017 selepas menjalani siri latihan dalam perisian WEKA. Hasil dari kajian ini, pengawasan yang baik mengenai jumlah pengambilan air perlu dilaksanakan dan semua LRA dicadangkan untuk menggunakan penilaian jejak air sebagai pendekatan bagi memastikan kecekapan penggunaan air.

ABSTRACT

Water stress in the world is becoming more alarming issue due to urbanisation. There are a lot of water related researches to address this issue (Chang, Chang, Huang, & Kao, 2016; Nguyen-ky et al., 2017; Rosecrans, Nolan, & Gronberg, 2017). This study focused on blue water footprint (WFblue) assessment in Semambu and Panching water treatment plants (WTPs). Then, the total WFblue will be modelled and undergo a series of training to predict the trend by using 2 algorithms which is Artificial Neural Network (ANN) and Random Forest (RF). In order to choose the best algorithm, comparison has been made between those two algorithms. The objectives of this research are; (1) to calculate the total WFblue in Semambu & Panching WTPs which are located in Kuantan river basin for the 2015-2017 period; (2) to predict the trend of total blue water footprint Semambu & Panching water treatment plants in Kuantan river basin; and, (3) to compare the best algorithm between ANN and RF in WFblue prediction model. Water intake, rainfall utilization and total evaporation will be taken into account in total WFblue calculation where WFblue can be defined as total water consumption within a product chain. at the end result of this research, the total blue water footprint prediction trend has been produced. The predicted trend of WFblue showed a decrement from 2015 until 2017 after undergoes training in WEKA software. From this research, correct monitoring of water intake amount need to be implemented and it is suggested that all WTPs applies water footprint assessment as an approach to ensure the efficiency of water utilization

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LIST OF SYMBOLS

ET_o	Evapotranspiration
WF_{blue}	Blue Water Footprint
WF_{grey}	Grey Water Footprint
WF_{green}	Green Water Footprint
CO_2	Carbon Dioxide
H_2	Hydrogen
NH_3	Ammonia
T_{mean}	Mean Daily Temperature
ρ	Mean Daily Percentage

LIST OF ABBREVIATIONS

WWO	World Water Organization
WF	Water Footprint
WFblue	Blue Water Footprint
ANN	Artificial Neural Network
RF	Random Forest
WFA	Water Footprint Assessment
WFN	Water Footprint Network
WTP	Water Treatment Plant
WWTP	Waste Water Treatment Plant
GIS	Geographical Information Services
FAO’s	Food Agriculture Organization of United Nations
SWAT	Soil and Water Assessment Tool
HRB	Haihe River Basin
BWFI	Blue Water Footprint Index
ULB	Upper Litani Basin
PUNN	Product Unit Neural Network
MLP	Multi-Layer Perceptron
FFBP	Feed Forward Back Propagation
GR	Generalized Regression
RBF	Radial Basis Function
RMSE	Root Mean Square Error
CSV	Common Separated Value

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Water is a fundamental natural resource that plays an important role for humans, animals, plants and environment development (Dur, 2018). Adequate water supply can help in accomplishing duties and responsibilities for many parties. Human needs fresh water for their daily used and agricultural activities where a statistics shows that agricultural sector companies is the largest consumer of water which is 62% followed by 21% of company and 17% of domestics (Lucia, Maiello, & Quintslr, 2018). Besides, water are also important to the environment as a support for the biological process and to stabilize global temperature. Water supply sources come from water catchment areas including rivers, lakes and also reservoirs. It is reported by World Water Organization (WWO) in 2010 that water demand in the world rapidly increasing which has tripled since 1950. 70% of the world is surrounded with water but the amount of fresh water supply is relatively limited compared to saline. However, a good quality of water is difficult to obtain even in the country that be blessed with fresh water resources.

The existing water supply in a region can be exhausted when the population grows drastically. The process of delivering water from the source area to the city can be negatively affect the environment as well as intensive farming activities. Furthermore, when the population in the world increase, the development of a country will increase rapidly and requires adequate water supply for the use (Asare, Zhao, Asante, & Nyarko, 2018) . This is because it is expected that the world's population will all live in the city by 2050. The progress of development in any country needs a wide area which sometimes required to cut off trees and elimination of catchment areas where will cause global temperature rise. The occurrence of this incident will automatically reduce the sources of water supply in a country. Government parties need to plan the future development wisely in order to prevent the exhausting of water supply.

Uncontrolled climate changes will also be a problem in providing enough water supply especially for the management in the water treatment plants. Some countries in the world experience hot and rainy weather throughout the year which can affect in the water purification process. Natural water sources that will be treated at water treatment plants getting lesser in prolonged summer while in the rainy season, water treatment plants may not be able to accommodate a large amount of water at any given time.

Pollution of water that often occurs will make the supply of clean water been disturbed (Udimal, Jincai, Ayamba, & Owusu, 2017) . This happen when unscrupulous parties like in industrial areas that release toxic waste directly into the river. Water treatment plants unable to remove all contaminated substances that mixed with the river water, thus the quality of water to be deliver are not guaranteed. Treating the waste water before releasing it into the water body will give a little bit help to reduce water pollution scale. Moreover, poor management in development activities will also lead to pollution. Poor management here mean when the parties are doing uncontrolled tree cutting, proper waste cleaning need to be done. If the waste just be left on the ground, probability of the substances to enter the river is high which can interfere with the use of water by agricultural and other sectors.

Water footprint (WF) can be used to measure water resource requirements by the consumers for the products and services (Hogeboom, Knook, & Hoekstra, 2018). Water footprint assessment is a process to evaluate the sustainability and efficiency of water consumption and establish which actions should be preferred in order to have sustainable footprint. Water footprint can be classify into three components which is grey, green and blue water footprint. This study focuses on blue water footprint assessment to assess full water utilization in the water treatment plants. Furthermore, water footprint assessment is multi-purpose which can produce wide range of information from different perspectives. From water footprint assessment, the total amount of water consumed within a process can be identified.

1.2 Problem Statement

Water treatment is a process that improves the quality to make it be accepted for any specific use. The end use of the treated raw water may be for industrial water supply, economics and including being return safely to the environment. In regard, a study will be conducted at water treatment plants which most of the source of water comes from Kuantan river basin. Nonetheless, most of the water treatment plants are still managed by using the old method. This method still can be used but ineffective due to some issues. One of the issues are the data about rainfall and evaporation of water are not recorded which can bring problem for the treatment plants. For a country who are in the equator such as Malaysia, the relevant parties will face the problem in retrieving the missing

By 2030, water demand is expected to grow 50% due to the rapidly increasing of the population in the world. The increasing number of population will be mostly in the cities because it will be about 70% of the world's population will live in the cities in 2050, compared to 50% today (UN-Habitat,2016). In this context, the provision of a good quality of water is important for the commercial use of the population. If a good quality of water cannot be issued, any activities that require water usage such as industrial development will be disrupted. This problem will also affect the income source of a country.

The water footprint measures large volume of water resources used to provide goods and services. Water footprint can be classified into three components which is blue, green and grey. These components give a clear picture of the water consumption as the amount of water needed for assimilation of pollutants. Water footprint can be used to observe the level of efficiency that water treatment plants can achieved in purifying water resources (Dur, 2018). This study will focusing on blue water footprint which is an indicator of surface and groundwater needed and also refers to the amount of water used to create a product.

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